ACIDIC FOOD CHOICE

PUECH P.-F. pfpuech@yahoo.fr

Homo and *Australopithecus* have teeth covered with a thick layer of enamel, much thicker than found among living apes. Richard Kay quantified molar enamel thickness in monkeys and apes and found that thick enamel often crack open extremely hard nuts (1984, “On the use of anatomical features to infer foraging behaviour in extinct Primates” in: *Adaptations for foraging in nonhuman Primates*, Rodman P.S. and Cant J.G.H. eds., pp. 21-53).
Thick enamel has evolved several times in parallel among species that eat hard food, for example: fossil orang-utan, one large big ape and therefore foraging terrestrially, developed big teeth with a thick layer of enamel (figure n°1, large *Pongo* lower molar that von Koenigswald described). The physical properties of food are thus expected to have influenced the thickness of enamel, but chemical nature of diets must also be considered since enamel resistance is highly influenced by acid variation.

Tooth wear caused by foods affect the enamel and dentine. It is referred to as “three-body wear” because there are three surfaces in function -the tooth and either soft tissue or the opposite tooth on the food substrate.
Conditions of wear can be inferred from the appearance of the tooth surfaces since degradation of tooth surface produced by food, e.g. slurry wear, comes from abrasion and erosion. The terms describing manifestations rather than the underlying wear mechanisms.
The different types of wear process in relation with diet are surface fatigue, friction producing adhesive wear, fretting, and chemical erosion. The aspects thus result from a large sum of effects.
-Abrasive wear is defined as the wearing of tooth substance resulting from exogenous material forced over the surface.
-Erosion refers to superficial loss of dental hard tissue due to chemical demineralization combined with mechanical factors.

-Attrition is defined as tooth wear caused by tooth-to-tooth contact without the presence of food (figure n°2).
-Abfraction results from flexure associated with heavy loading producing chips of the tissues.

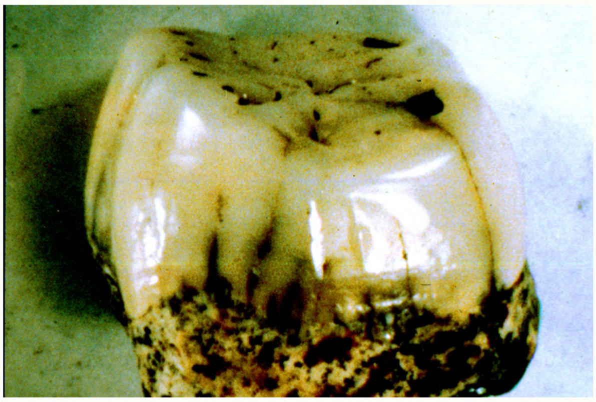


Fig. 1: Orang-utan fossil teeth. Photo ©PF Puech

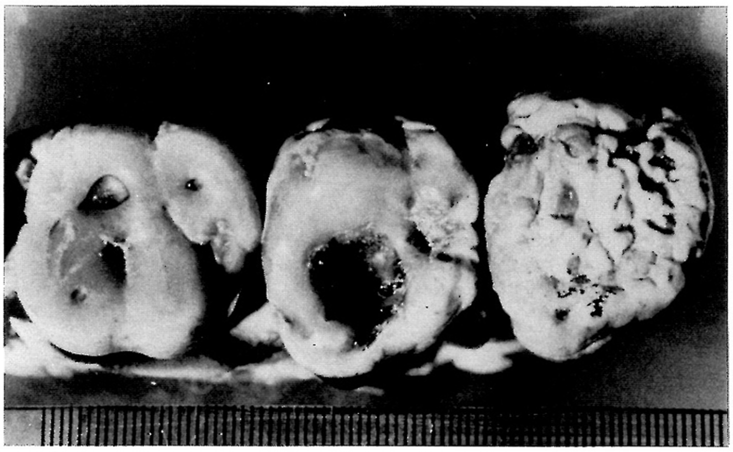
Fig.2: Attrition. Photo ©PF Puech

Erosive wear, the purpose of the present paper, is characterized by cupping and notching of the surfaces (figures n°3-4). Dentine usually wears faster than enamel but under acidic conditions enamel wears more rapidly. But there are other factors, for instance the rate of wear of enamel are lower than that of dentine at low loads in a neutral environment but the rates are comparable at higher loads due to the harder but more brittle nature of enamel and the more elastic nature of dentine.

Fig. 3: Cupping and grooving of the surfaces with restoration rising slightly are clinical signs of erosion. Photo ©PF Puech

Fig. 4: Olduvai Hominid 7 with comparable occlusal dental wear. Photo ©PF Puech

CURRENT ANTHROPOLOGY Vol. 25, No. 3, June 1984: 349-350



Burnished second upper right molar in Olduvai Hominid 16 and the localized erosion attributed to the chewing of resistant acidic vegetables (Courtesy of P. V. Tobias).

Acidic-Food Choice in *Homo habilis* at Olduvai[1]

by PIERRE-FRANÇOIS PUECH
Laboratoire de Préhistoire du Musée de l'Homme

Olduvai Hominid 16 presents a kind of erosion of the crown of the second maxillary molar that has recently been noted in juveniles who chew aspirin for the relief of rheumatoid arthritis and thus can be directly related to the injurious effects of chewing resistant acidic material.

The Olduvai *Homo habilis* fossils are the type series of the early representatives of the genus *Homo*. Dated by associated geological deposits to ca. 1,750,000 years, they lived side by side with at least one species of *Australopithecus: A. boisei* (Leakey, Tobias, and Napier 1964). The large habiline male O.H. 16, nicknamed "Olduvai George," revealed dental anomalies. The lower teeth occluded mesially to their normal position with their maxillary homologues, and the second molars had localised erosion that was the result of a chewing habit (Tobias 1974). This is the oldest pathology observed in the genus *Homo*.

The results of computer research on iatrogenic tooth wear in juvenile arthritics (Sullivan and Kramer 1983) contribute to an understanding of the cause of the abnormality seen in the teeth of O.H. 16. In the children who chewed aspirin tablets, the acidic action caused erosion confined to the areas of the major occlusal pit, especially in the first and second molars, the teeth used for grinding. In O.H. 16 the concave erosion occurs on the second molars, where the compressive forces are greatest. Situated mesiobuccally on the occlusal surface, it indicates an increase in the hardness of the dentine following a reactive change. The factors responsible for these features acted in combination. Food accumulated in the major occlusal pit, and because the enamel there was thinner the topical effect was the more injurious.

If an acidic substance was the cause of this erosion in the case of *H. habilis,* it could have been the result of the regurgitation of stomach contents or the consumption of acidic plant foods. The amount of erosion is influenced by several factors: pH, duration of contact with the teeth, the buffer capacity of the saliva, and enamel resistance. In vivo it is the lingual surfaces of the upper teeth that are affected by regurgitation and the buccal surfaces of the anterior teeth by the consumption of ripe acidic fruits. The position of the erosion on the teeth of O.H. 16 would indicate that the injury was the result of chewing fibrous acidic plant foods such as certain immature fruits. When such fruits were crushed between the molars, they would split, and the fibres would pack into the occlusal pits.

Examined microscopically, the teeth of other *H. habilis* specimens from a different bed at Olduvai reveal evidence of enamel and dentine erosion (fig. 1). The erosion is minimal, apparently affecting only the enamel surface irregularities and beginning to dissolve the dentine, which is slightly scooped out. From the similarities of this tooth wear it would appear that the various Olduvai habilines chose similar diets. Nitrocellulosic impressions of the tooth surfaces viewed under ×50 magnification reveal persuasive evidence of food choice for both *H. habilis* and *A. boisei* (fig. 2). The distinctive features of *H. habilis* are very few striations and an etched enamel surface, whilst *A. boisei* is characterized by wide parallel striations. Excavations of undisturbed artifact clusters and food refuse areas indicate hunting and butchering by *H. habilis* (Leakey 1971). However, the erosion of the teeth under consideration here could not have been the result of meat eating but must have come from the acidic action of plant foods.

Ripe fruits are a dietary staple for apes. In some areas, however, orangutans are seasonal unripe-fruit specialists (McKinnon 1971). They break open these fruits with their teeth, and the latter have a distinctive surface pattern characteristic of erosive action (fig. 3).

[1] Thanks are extended to Mary D. Leakey for her kind permission to examine the Olduvai Gorge fossils, to Henri Albertini and Henry and Marie-Antoinette de Lumley for their aid and encouragement, and to F. Filce Leek for reading the manuscript and offering a number of suggestions. This work was generously assisted by Laboratory Goupil and Agfa-Gevaert, Marseille.

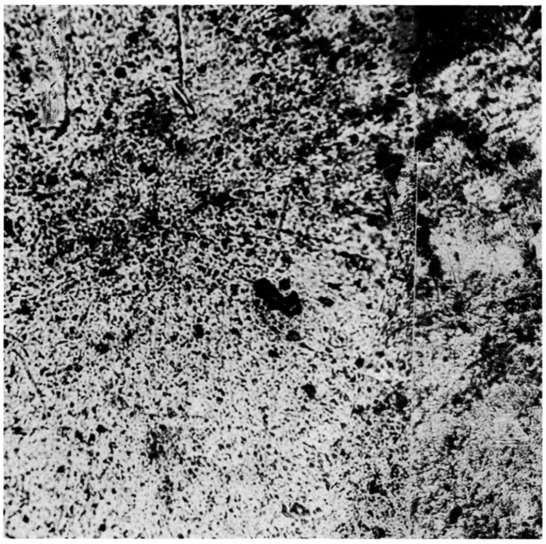


FIG. 1. Entoconid surface of right lower first molar of Olduvai Hominid 7, ×50, showing etched enamel.

FIG. 2. Entoconid surface of right lower first molar of *A. boisei* from Peninj, Tanzania, ×50, showing distinctive wide parallel striations.

FIG. 3. Surface of orangutan tooth, ×50, showing erosion of enamel.

The evidence of dental microwear supports the conclusion of Susman and Stern (1982) that *H. habilis* was capable of sleeping, fleeing, and feeding in trees. Furthermore, it has been established that in southern and eastern Africa fruits are the main food item exploited by contemporary hunter-gatherers (Peters and O'Brien 1981) and that some very acid fruits are acceptable to many. One example is the lemon, which has a pH of 2.8; an acid reaction of below pH 5.5 results in a dissolution of the inorganic parts of teeth.[2] The nature of the erosion on the teeth of *H. habilis* is evidence of a high degree of utilisation of few food sources at Olduvai. Comparative microwear analyses and archaeological documentation (Leakey 1971, Bunn 1981) now provide conclusive evidence of meat and acidic-fruit eating by *H. habilis*.

References Cited

BUNN, H. T. 1981. Archaeological evidence for meat-eating by Plio-Pleistocene hominids from Koobi Fora and Olduvai Gorge. *Nature* 291:574–76.

LEAKEY, L. S. B., P. V. TOBIAS, and J. R. NAPIER. 1964. A new species of the genus *Homo* from Olduvai Gorge. *Nature* 202:7–9.

LEAKEY, M. D. 1971. *Olduvai Gorge*. Vol. 3. *Excavations in Beds I and II, 1960–1963*. London: Cambridge University Press.

MCKINNON, J. 1971. The orang-utan in Sabah today. *Oryx* 2:141–91.

NISHIDA, T., R. W. WRANGHAM, J. GOODALL, and S. UEHARA. 1983. Local differences in plant-feeding habits of chimpanzees between the Mahale Mountains and Gombe National Park, Tanzania. *Journal of Human Evolution* 12:467–80.

PETERS, C. R., and E. M. O'BRIEN. 1981. The early hominid plant-food niche: Insights from an analysis of plant exploitation by *Homo, Pan,* and *Papio* in eastern and southern Africa. CURRENT ANTHROPOLOGY 22:127–40.

SULLIVAN, R. E., and W. S. KRAMER. 1983. Iatrogenic erosion of teeth. *Journal of Dentistry for Children* 50(3):192–96.

SUSMAN, R. L., and J. T. STERN. 1982. Functional morphology of *Homo habilis*. *Science* 217:931–34.

TOBIAS, P. V. 1974. Aspects of pathology and death among early hominids. *The Leech* 44 (3):119–24.

[2] Comparison of the plant-feeding habits of chimpanzee populations in Gombe National Park and the Mahale Mountains (Tanzania) has revealed striking differences. In Gombe, the unripe fruits of *Hymenocardia acida* are eaten in August-September. The fruit tastes rather lemony and sour and is not eaten by chimpanzees in the Mahale (Nishida et al. 1983).